From: Joel Greenberg <rfacer@ix.netcom.com>
Sent: Monday, August 28, 2006 5:10 PM
To: MLPAComments@resources.ca.gov
Subject: MLPAComments: ATTN: Melissa
Importance: High

Hi Melissa . . .

Here's the document we just spoke about.

For my piece of mind, I would appreciate you reply that you received it.

Thanks for all your hard work!

Warmest Regards . . .

-Joel

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Seeking Consensus on Designing Marine Protected Areas: Keeping the Fishing Community Engaged

MARK HELVEY

National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Long Beach, California, USA

A community group was formed to consider establishing marine reserves within the Channel Islands National Marine Sanctuary in southern California. Membership included representatives from resource agencies, environmental organizations, commercial and recreational fishing interests, and the general public. While the group agreed on several areas for fishing closures, members could not reach consensus on a specific network design. Several factors interfered with the group's effort in attaining agreement resulting in the endeavor subsequently being replaced by a "top-down" approach that lacks the support of the fishing community. Lessons learned from the project emphasize the need by marine protected area participants to recognize irreconcilable impasses early in the process and to seek solutions to maneuver around them. The importance of keeping the fishing community fully engaged is discussed.

Keywords Channel Islands, community participation, MPAs, marine reserves

Introduction

While protecting marine habitats from fishing dates back centuries to the island communities of the South Pacific Ocean (Johannes, 1978), the use of marine protected areas (MPAs) has only become popular in the last several decades. One version of this conservation tool that fully protects areas from all harvest activity (i.e., harvest refugia, marine reserves, or no-take MPAs), has rapidly emerged as the MPA of choice (e.g., Allison, Lubchenco, & Carr, 1998; Guénette, Lauck, & Clark, 1998; Murray et al., 1999; Lubchenco et al., 2003). In 1999, the California Fish and Game Commission (Commission) was approached by the Channel Islands Marine Resource Restoration Committee, a group of concerned citizens, to consider setting aside 20% of the shoreline and waters to 1 mile within the 1,252 nmi^2 boundaries of the National Oceanic and Atmospheric Administration's

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Address correspondence to Mark Helvey, Habitat Conservation Division, Southwest Region, NOAA Fisheries, 501 W. Ocean Boulevard, Suite 4200, Long Beach, CA 90802, USA. E-mail: mark.helvey@noaa.gov

(NOAA) Channel Islands National Marine Sanctuary (Sanctuary)[1] as a "no-take" marine reserve (Ugoretz, 2002). In response, the Commission directed the California Department of Fish and Game (CDFG) to work with Sanctuary staff to consider marine reserves within the Sanctuary's boundaries. The Commission's request was facilitated by the Sanctuary's Advisory Council (SAC). The SAC, an advisory body to the Sanctuary manager, is composed of 20 members representing a variety of local user groups, the general public, and local, state, and federal governmental jurisdictions. They appointed a multi-stakeholder Marine Reserves Working Group (MRWG) to develop and forward to them a consensus recommendation for establishing marine reserves within the Sanctuary.

The MRWG was formalized in July 1999, and its 17 members represented a broad array of community responsibilities and perspectives, including state and federal resource agencies, the public-at-large, commercial fishing, kelp harvesters, commercial passenger fishing vessels, recreational fishermen and divers, and environmental organizations.

The SAC also formed a Science Advisory Panel (SAP) and a Socio-Economic Team (SET) to support the MRWG in its decision making. The 15-member SAP defined scientific criteria, evaluated ecological data, and critiqued the scientific merits of different reserve scenarios provided by the MRWG. The five-member SET provided baseline socioeconomic information and conducted an impact analysis on use values associated with various marine reserve scenarios and their potential costs.

The MRWG operated on a common set of self-imposed ground rules that procedurally directed its decision making (Figure 1). Decisions were based on consensus (i.e., unanimity) that required all members to at least reach a predetermined level of agreement for a proposal to be adopted. Using these guidelines, the MRWG corroborated on several issues, including adopting problem and mission statements, a set of implementation recommendations, and five goals. Of the goals, two focused specifically on the biological outcomes of marine conservation and sustainable fisheries. The remaining three addressed socioeconomic, heritage and educational concepts (Table 1). The MRWG agreed to neither prioritize nor weight the five goals.

The MRWG operated for 22 months, from July 1999 to May 2001. The monthly, day-long meetings were managed by two professional facilitators. Despite this well-organized effort, the group disbanded without reaching consensus on a marine reserve network to forward to the SAC. While the group did agree on fishing closures at nine locations within the Sanctuary, it was unable to agree on the size of each. Over a period of several months, these common "areas of overlap," totaling 18% of the Sanctuary boundaries, represented the maximum area MPA critics were willing to concede, but of insufficient size to accommodate concerns expressed by MPA proponents.[2] Consequently, a composite map illustrating both positions was prepared and forwarded to the SAC (Figure 2).

Due to this impasse, the SAC acknowledged it was unprepared to complete the MRWG's task and recommended to the Sanctuary manager that Sanctuary staff collaborate with CDFG staff to formulate a marine reserve design based upon the substantial work products prepared by and for the MRWG. This task subsequently resulted in an MPA network design affecting 25% of the Sanctuary's boundaries that includes both no-take and limited-take fishing areas. Nineteen percent of this network occurs in State of California waters (shoreline to 3 nmi), and the remaining 6% in the Federal waters portion (3–6 nmi) of the Sanctuary. The State's portion was implemented in April 2003. The Federal portion is currently advancing through the National Environmental Policy Act process.

Why was the MRWG unable to reach consensus on a single map, thereby losing the support of the fishing community? The stalemate can be traced to a number of factors that interfered with the group's decision making. Certain decisions and events occurred early in the process that directly or cumulatively impeded the MRWG's ability to look

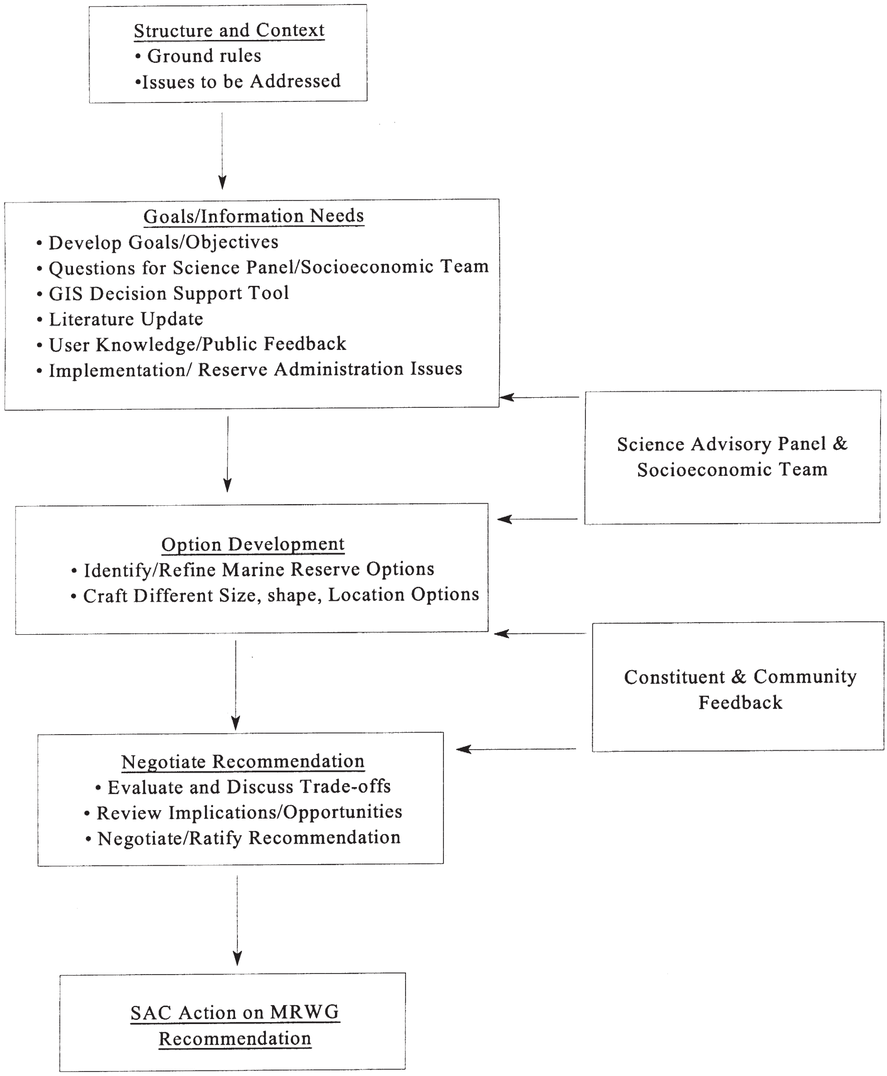

Figure 1. Schematic of the marine reserve working group (MRWG) planning process.

beyond differences of opinion and seek solutions to its disagreements over such a complex management issue. This commentary attempts to present six findings that address particular issues that in one way or another affected the MRWG's ability to reach unanimity on a single map. It also reviews the success and failures arising out of the MRWG project. The paper concludes by suggesting ways the group might have maneuvered around its impasse and what future MPA efforts need to consider to preserve full community participation.

Findings

Inadvertently Weighting the Ecosystem Biodiversity Goal

One exercise undertaken early in the MRWG process was identifying particular organisms that would benefit from the creation of a marine reserve network in the Sanctuary.

Table 1
Goals for marine reserves adopted by the Marine Reserve Working Group (adopted from Jostes and Eng, 2001)

Goal	Goal definition
Biological	
Ecosystem biodiversity	To protect representative and unique marine habitats, ecological processes, and populations of interest.
Sustainable fisheries	To achieve sustainable fisheries by integrating marine reserves into fisheries management.
Social and Economic	To maintain long-term socioeconomic viability while minimizing short-term socioeconomic losses to all users and dependent parties.
Natural and Cultural Heritage	To maintain areas for visitor, spiritual, and recreational opportunities, which include cultural and ecological features and their associated values.
Educational	To foster stewardship of the marine environment by providing educational opportunities to increase awareness and encourage responsible use of resources.

The group prepared a list of seven criteria to guide an iterative process that eventually produced a diverse list of 119 plant, invertebrate, fish, seabird, and marine mammal "species of interest" (Table 2). The list represented both unharvested organisms, including corals, gorgonians, barnacles, seals, sea otters, and marine birds, as well as harvested fish and plant species (e.g., kelp).

The creation of the species list essentially established the scale of the marine ecosystem under which the MRWG and its advisory panels would operate. Considering ecosystems are defined as the network of interactions amongst and between organisms and their environment within a given area, the expansive species list represented a broad system even including a pelagic component of migratory fish species (e.g., white sea bass, Pacific sardine and northern anchovy). Although the MRWG intentionally decided against weighting its five goals, the expansive species list inadvertently placed a greater emphasis on the ecosystem biodiversity goal from the very outset of its deliberations.

To accommodate the full complement of species, the SAP suggested using suitable habitat types as a proxy for spatial distributions, as the latter information was unavailable for many species (Table 3). The SAP also identified three biogeographical zones or regions to frame the oceanographic variability operating within the Sanctuary. These regions were the colder waters of the northern Oregonian Bioregion, the warmer waters of the southern California Bioregion, and the middle Transition Zone (Airamé et al., 2003). With the three regions in mind, the SAP recommended that the representative habitat types be included in each to ensure habitat coverage for the full complement of species (Airamé et al., 2003). Consequently, the MRWG was challenged to thrice replicate protection for the various habitat types in each region rather than once over the range of the Sanctuary. This guidance further reinforced a predisposition towards

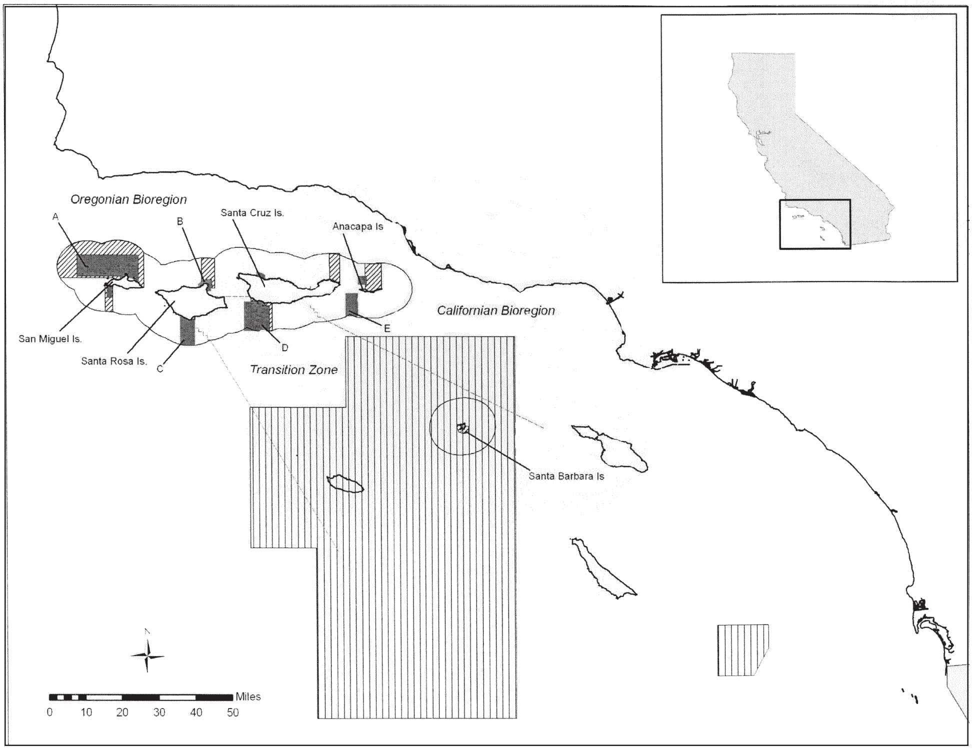

Figure 2. Composite map of areas of overlap (darkened areas) and nonoverlap (cross-hatch) developed by the Marine Reserves Working Group (MRWG) at the Channel Islands National Marine Sanctuary and the Pacific Fishery Management Council's "cowcod conservation area" (vertical-hatch). Lettered areas are: A = Richardson Rock; B = Carrington Point; C = South Point; D = Gull Island; E = Footprint.

the ecosystem biodiversity goal and complicated attempts to seek balance amongst the five goals.

Establishing Policy on Habitat Quantity

Early in its process, the MRWG requested that the SAP recommend a marine reserve scenario supporting the two biological goals of ecosystem biodiversity and sustainable fisheries. Upon conducting a review of the scientific literature, the SAP reported a wide array of optimal marine reserve sizes ranging from 5–80% of the available habitat listed in the studies. The SAP disclosed that most of the literature indicated a minimum of 10–40% of marine habitats would need protection to conserve ecosystem biodiversity. For the sustainable fisheries goal, it noted that most studies suggested a need to protect 30–60% of existing fishing grounds. Based on this review and the intent to achieve both biological goals, the SAP suggested that at least 30% and possibly 50% of each of the representative marine habitats in each of the three zones be established in the Sanctuary (SAP, 2001; Airamé et al., 2003).

Given the extensive species list, the limited information on the distributions and movements of many of the species of interest, and the complexity of the three interacting biogeographical water masses, the SAP provided its best estimate for the total size of no-take reserves. While the list of studies reviewed by the SAP in its decision was

Table 2
Species of interest in the northern Channel Islands
for consideration by the Marine Reserve Working Group

Species	Scientific name
Plants	
Giant kelp	*Macrocystis pyrifera*
Feather boa kelp	*Egregia menziesii* and *E. laevigata* (Setchell 1925)
Elk kelp	*Pelagophycus porra*
Oar weed	*Laminaria farlowii*
Brown algae	*Agarum fimbriatum*
Southern sea palm	*Eisenia arborea*
Stalked brown algae	*Pterygophora californica*
Scoulder surfgrass	*Phyllospadix scoulei*
Torrey surfgrass	*P. torreyi*
Eelgrass	*Zostera* spp.
Invertebrates	
California hydrocoral	*Allopora californica*
Hydroid	*Abietinaria* spp.
Ostrich-plume hydroid	*Aglaophenia latirostris*
Ostrich-plume hydroid	*A. struthionides*
Hydroid	*Clytia bakeri*
Hydroid	*Garveia annulata*
Hydroid	*Obelia* spp.
Hydroid	*Sarsia* spp.
Hydroid	*Sertularella turgida*
Hydroid	*Sertularia frucata*
Hydroid	*Tubularia crocea*
Red gorgonian	*Lophogorgia chilensis*
California golden gorgonian	*Muricea californica*
Brown gorgonian	*M. fructicosa*
Colonial sand tube worm	*Phragmatopoma californica*
Giant acorn barnacle	*Balanus nubilus*
Aggregating anemone	*Anthopleura elegantisima*
Giant starfish	*Pisaster giganteus*
Ochre starfish	*P. ochraceus*
California sea cucumber	*Parastichopus californicus*
Warty sea cucumber	*P. parvamensis*
Red sea urchin	*Strongylocentrotus franciscanus*
Purple sea urchin	*S. purpuratus*
Pink abalone	*Haliotis corrugata*
Black abalone	*H. cracherodii*
Green abalone	*H. fulgens*
Red abalone	*H. rufescens*
White abalone	*H. sorenseni*
Owl limpet	*Lottia gigantea*
Wavy turban snail	*Lithopoma undosa*
Kellet's whelk	*Kelletia kellettii*

Table 2
Species of interest in the northern Channel Islands
for consideration by the Marine Reserve Working Group (*Continued*)

Species	Scientific name
Invertebrates (*Continued*)	
California mussel	*Mytilus californianus*
Rock scallop	*Hinnites giganteus (multirugosus)*
Pismo clam	*Tivela stultorum*
Geoduck clam	*Panopea generosa*
Market squid	*Loligo opalescens*
California spiny lobster	*Panulirus interruptus*
Red rock shrimp	*Lysmata californica*
Spot prawn	*Pandalus platyceros*
Ridgeback shrimp	*Sicyonia ingentis*
Red crab	*Cancer productus*
Rock crab	*C. antennarius*
Sheep crab	*Loxorhynchus grandis*
Fish	
Leopard shark	*Triakis semifasciata*
Pacific angel shark	*Squatina californica*
Soupfin shark	*Galeorhinus galeus*
Thornback ray	*Platyrhinoidis triseriata*
Pacific herring	*Clupea pallasii*
Pacific sardine	*Sardinops sagax*
Northern anchovy	*Engraulis mordax*
Pacific cod	*Gadus macrocephalus*
California grunion	*Leuresthes tenuis*
California scorpionfish	*Scorpaena guttata*
Pacific ocean perch	*Sebastes alutus*
Kelp rockfish	*S. atrovirens*
Brown rockfish	*S. auriculatus*
Gopher rockfish	*S. carnatus*
Copper rockfish	*S. caurinus*
Greenspotted rockfish	*S. chlorostictus*
Black and yellow rockfish	*S. chrysomelas*
Darkblotched rockfish	*S. crameri*
Starry rockfish	*S. constellatus*
Calico rockfish	*S. dallii*
Widow rockfish	*S. entomelas*
Cowcod	*S. levis*
Black rockfish	*S. melanops*
Vermilion rockfish	*S. miniatus*
Sebastes miniatus	*S. mystinus*
Speckled rockfish	*S. ovalis*
Bocaccio rockfish	*S. paucispinis*
Canary fockfish	*S. pinniger*
Grass rockfish	*S. rastrelliger*

(*Table continues next page*)

Table 2
Species of interest in the northern Channel Islands for consideration by the Marine Reserve Working Group (*Continued*)

Species	Scientific name
Fish (*Continued*)	
Yelloweye rockfish	*S. ruberrimus*
Flag rockfish	*S. rubrivinctus*
Olive rockfish	*S. serranoides*
Treefish	*S. serriceps*
Honeycomb rockfish	*S. umbrosus*
Shortspine thornyhead	*Sebastolobus alascanus*
Lingcod	*Ophiodon elongatus*
Cabezon	*Scorpaenichthys marmoratus*
Giant sea bass	*Stereolepis gigas*
Broomtail grouper	*Mycteroperca xenarcha*
Kelp bass	*Paralabrax clathratus*
Ocean whitefish	*Caulolatilus princeps*
White seabass	*Atractoscion nobilis*
Halfmoon	*Medialuna californiensis*
Black surfperch	*Embiotoca jacksoni*
Barred surfperch	*Amphistichus argenteus*
Shiner surfperch	*Cymatogaster aggregata*
Walleye surfperch	*Hyperprosopon argenteum*
Silver surfperch	*H. ellipticum*
Rubberlip surfperch	*Rhacochilus toxotes*
Blacksmith	*Chromis punctipinnis*
Garibaldi	*Hypsypops rubicundus*
California sheephead	*Semicossyphus pulcher*
Tidewater goby	*Eucyclogobius newberryi*
California halibut	*Paralichthys californicus*
Starry flounder	*Platichthys stellatus*
C-O turbot	*Pleuronichthys coenosus*
Birds	
California least tern	*Sterna antillarum browni*
Pigeon guillemont	*Cepphus columba*
Xantus' gurrelet	*Synthliboramphus hypoleucus*
Cassin's auklet	*Ptychoramphus aleuticus*
Marine mammals	
Harbor seal	*Phoca vitulina*
Northern fur seal	*Callorhinus ursinus*
Southern sea otter	*Enhydra lutris nereis*

Note. The list was prepared based on the following criteria: (1) economically and/or recreationally important species, (2) keystone or dominant species, (3) species listed or proposed for listing under the Endangered Species Act (ESA), (4) species showing long-term declines in harvest and/or size structure, (5) habitat-forming species, (6) indicator or sensitive species, and (7) important prey species.

Table 3
List of representative and unique marine habitats considered by the Marine Reserves Working Group

Sandy coasts
Rocky coasts (protected)
Rocky coasts (exposed)
Soft sediment (0–30 m)
Hard sediment (0–30 m)
Soft sediment (30–100 m)
Hard sediment (30–100 m)
Soft sediment (100–200 m)
Hard sediment (100–200 m)
Soft sediment (>200 m)
Hard sediment (>200 m)
Emergent rocks (nearshore)
Emergent rocks (offshore)
Submarine canyons
Kelp forest
Eelgrass
Surfgrass

documented (SAP, 2001), the derivation of the 30–50% range was not disclosed. The approach taken by the SAP seems to contradict the notion that allocating habitat to marine reserves requires implementing a consistent, logical procedure rather than a simple single number (Mangel, 2000a) or, as in this case, a particular range. Considering that science is a process based upon rigorous methodologies and empirically justifiable outcomes, the 30–50% recommendation appeared more as a statement of policy. The Pacific Fishery Management Council's (Pacific Council) Science and Statistical Committee (SSC) advisory body reviewed the SAP's size recommendation and concluded this to be the case (PFMC, 2001).

Given the SAP's recommendation, habitat quantity soon became the overarching issue in the reserve design debate and essentially became a goal unto itself. Some members of the MRWG readily accepted the 30–50% recommendation as "best available science" and sought a minimum size threshold close to the 30% level. In contrast, MPA critics, not inclined to endorse the recommendation, were content with a size closer to the original 20% proposal placed before the Commission in 1998. The opposing positions that were beginning to emerge on the size issue would subsequently interfere with opportunities to negotiate compromise between the two sides.

Not Acknowledging the Uncertainty of Fishery Benefits

When closing areas to fishing, benefits can be separated into the ecological responses occurring within the reserve and the potentially improved fishery yields outside. Yet, the evidence supporting both outcomes is not analogous. A sizable number of studies have documented the significant positive changes occurring within reserves, and these have been summarized in several reviews (Roberts & Polunin, 1991; Dugan & Davis, 1993; Guénette, Lauck, & Clark, 1998; Sumaila et al., 2000; Halpern, 2003). In general, these examinations report that marine reserves lead to increases in density, biomass, individual size, and diversity for most fish and invertebrate species, although some exceptions do exist (Zeller & Russ, 1998).

A similar level of documentation on fishery benefits does not exist. Although empirical evidence documenting fishery responses outside of reserves is emerging (McClannahan & Mangi, 2000; Murawski et al., 2000; Roberts et al., 2001; White, Courtney, & Salamanca, 2002), it is acknowledged that there is a clear shortage of scientifically defensible studies (Crowder et al., 2000; Soh, Gunderson, & Ito, 2001; Jamieson & Levings, 2001; Polunin, 2002; Willis et al., 2003). Further, modeling efforts have shown various and sometimes conflicting results, and their potential benefits to fisheries are not yet predictable (Willis et al., 2003). Conclusions drawn from these efforts depend on several poorly understood life history parameters, including larval survivorship, fecundity–size relationships (Sladek Nowlis & Roberts, 1999), and larval dispersal and behavior (Stobutzki, 2001; Botsford, Micheli, & Hastings, 2003). Further, other little known parameters that can influence reserve function such as home range size and spillover rates must also be factored into the design process (Kramer & Chapman, 1999; Jennings, 2001).

Absent from the MRWG discussions was acknowledgment of the differences in scientific certainty between the inside and outside benefits. The effectiveness of marine reserves in fisheries management is poorly understood and concepts regarding their use are for the most part untested (Soh, Gunderson, & Ito, 2001; Polunin, 2002; Willis et al., 2003). Proponents of MPAs, while correctly maintaining reserves to be an effective tool for ecosystem protection, stated a desire for maximum closures without apparently accounting for the ambiguous and unproven benefits to fisheries. The MPA critics took a more skeptical view of the purported fishery benefits and were not eager to concede large areas for closure. Polunin (2002) noted that such a doubtful position "is well justified on scientific grounds." However, this skepticism may have also reflected a frustration with accepting another form of fishing prohibition at a time when the Pacific Council had adopted highly restrictive limits on the shelf rockfish group (Rogers-Bennett, 2001).

Overlooking the Expertise of Fishery Scientists

The composition of the SAP represented a wide range of scientific expertise. These experts were identified by a subgroup of the SAC that matched potential candidates with a set of prepared criteria.[3] Although scientists from two fishery agencies did participate and many SAP members were knowledgable in fishery biology, specific expertise in stock assessment science and existing fishery management measures and fishing practices was missing.

Because the issue of marine reserves deals with regulating fisheries, participation by fishery scientists with the aforementioned competence could have ensured that fishery policies were appropriately identified and correctly interpreted. For example, the SAP contended that the 30–50% reserve size recommendation was equivalent to the Pacific Council's 40% default harvest rate policy, a policy designed to maintain groundfish biomass at 40% of the unfished level. However, while setting aside 40% of the available habitat might afford protection to 40% of the stock, no accounting of the stock residing outside the reserve was made. Consequently, the 30–50% recommendation may have underestimated the aggregate level of abundance, thereby invalidating its equivalency to the default harvest policy (PFMC, 2001).

The input of fishery science may have also highlighted the importance of considering existing fishing practices and regulations operating within and beyond the Sanctuary's boundaries. One of the strong arguments in favor of marine reserves is that they can complement traditional fisheries management aimed at controlling effort (Dugan & Davis, 1993; Bohnsack, 1998; Guénette & Pitcher, 1999; Soh, Gunderson, & Ito, 2001). Such a strategy requires accommodating spatial closures with catch and effort controls outside of closed areas as part of the design blueprint. As the SAP internally debated the marine reserve size issue, opportunities for developing a design scheme that incorporated existing fishing restrictions were missed. For example, a portion of the Sanctuary resides within the "cowcod conservation area," a limited-take MPA, established by the Pacific Council in 2000, that closed fishing for all species of rockfish (i.e., *Sebastes* spp.) lingcod (*Ophiodon elongatus*), California scorpionfish (*Scorpaena guttata*), and ocean whitefish (*Caulolatilus princeps*)) in waters deeper than 20 fathoms (Figure 2). The presence of this 4200 mi^2 MPA was not factored into the SAP's marine reserve size percentage recommendation, nor were the restrictive measures on shelf rockfish mentioned earlier. As observed by the SSC, attempts to integrate existing fishing effort controls with the SAP's 30–50% recommendation were apparently not made (PFMC, 2001).

Fishery scientists may have also been able to identify the benefits of marine reserves to particular fisheries. Modeling studies (Polacheck, 1990; DeMartini, 1993) and empirical evidence (McClanahan & Mangi, 2000; Roberts et al., 2001) suggest that fishery yields will improve for species with moderate movements that move across reserve boundaries as opposed to sedentary or highly mobile species (but see Bohnsack, 1999; Guénette & Pitcher 1999; Apostolaki et al., 2002). Specifically, highly mobile species should derive little benefit from marine reserves because they spend too much time outside of reserves to be afforded adequate protection (Kramer & Chapman, 1999; Parrish, 1999; Botsford, Micheli, & Hastings, 2003). Consequently, migratory species on the "species of interest" list, including northern anchovy, sardine and white seabass may be more successfully managed with traditional methods and not reserves (Parrish, 1999).

Timing the Presentation of Socioeconomic Analyses

While marine reserves can generate particular ecosystem benefits and "non-use values," they do incur socioeconomic or "opportunity" costs to affected users (Thomson, 1998). Costs can be measured along numerous dimensions, including hardships on local fishermen and fishery-dependent businesses, disproportionate impacts on bordering coastal communities, loss of customary fishing areas, and customary rights of access (NRC, 2001). Understanding how people interact with the marine ecosystem and how they may respond to fishing closures needs to be part of the decision-making process for reserve design and implementation (Fiske, 1992; Thomson, 1998; Pomeroy, 1999).

The importance of the socioeconomic consequences of marine reserve implementation was acknowledged by the SAC when it sanctioned the creation of the SET. The SET collected ethnographic data as well as demographic information on the total amount of usage, spatial distribution of usage, and revenues generated by the various commercial and recreational fishing industries including private household boaters operating within the Sanctuary. The intent of this information was to aid the MRWG in its reserve design deliberations so it could realize its socioeconomic goal of maintaining long-term socioeconomic viability while minimizing short-term socioeconomic losses to all users and dependent parties (Table 1). However, the SET encountered delays in getting started. As a result, it did not provide a complete impact analysis to the MRWG until six months after the SAP had already unveiled its 30–50% recommendation and after the MRWG had spent months mapping numerous reserve scenarios. While the various design options were consistently refined as new ecological information came forward, the SET was only able to provide periodic updates on the status of its different studies. Relative to the momentum generated by the continual refinement of map scenarios, the delayed release of the SET's impact analyses made it difficult for socioeconomic concerns to gain any credible traction in the MRWG's discussions. Consequently, consideration of socioeconomic information was neither afforded an equivalent role in the design process nor fully integrated into decision making as was ecological information.

Impediments to Negotiating Compromise

It is not unusual in complex negotiations that competing positions emerge between the diverse interests and backgrounds represented. In this effort, MPA proponents expressed an interest in maximum protection of habitat to fulfill the ecosystem biodiversity goal. This desire to set aside as much area within the Sanctuary as possible to approach the 30–50% size recommendation directly rivaled the MPA critics' position centering on the socioeconomic goal for minimizing short-term economic hardships.

The ability to balance competing goals requires skill in seeking tradeoffs and incorporating strategies that facilitate compromise by both sides. There was some effort to do this by members of the MRWG. For example, the concept of "phasing" in reserves over time was introduced as a way to temper short-term economic hardships to fishermen, as had been suggested by Bohnsack (1999). However, as competing arguments were raised, efforts to move this strategy forward were impeded by concerns over the size of the initial phase and the certainty of future phases (Jostes & Eng, 2001). The facilitation team was also inconsistent in enforcing one of the adopted ground rules requiring MRWG dissenters to offer viable alternatives when disagreements surfaced. The MRWG was also impeded by the inflexible instructions given by the SAC to only examine complete, that is, no-take, fishing closures. Consequently, less stringent management measures such as allowing some limited fishing to occur in an area (e.g., surface fishing for pelagic species), although discussed by the MRWG, were actually unavailable as bargaining tools. This may have been an unfortunate oversight. While limited-take zones do reduce the probability of protecting resources, they are less detrimental to the fishing community (Hilborn et al., 2001) and can be viewed as a way to accommodate multiple users (Agardy et al., 2003). Certainly, this management option was on the minds of Sanctuary and CDFG planners when they included some limited-take parcels in the MPA configuration currently in place.

Despite its design impasse, the MRWG did reach agreement on an extended list of "Monitoring, Evaluation, and Assessment Recommendations" in anticipation of finalizing a single design. The guidelines were intended to lay the foundation for future implementation activities. One concept captured in these recommendations and readily embraced by the MRWG was the method of adaptive management. A thorough familiarity with adaptive management may have compelled the group to treat their effort more as an experiment where decisions are considered ecosystem hypotheses and any subsequent management actions are considered treatments (Gunderson, 1999). For example, rather than becoming immersed in the size issue, the group could have settled on the areas of overlap as a starting point from which to begin an adaptive management experiment. Admittedly, changing the size of reserves may subsequently be difficult, if not impossible (Parma, NCEAS Working Group, 1998). However, there was little discussion on how adaptive management could be utilized as part of a design scheme suggesting, that the MRWG may have been impeded by not fully comprehending its potential use.

Discussion

Success or Failure?

Given the set of circumstances it created as well as those presented to them, the MRWG's effort eventually became embroiled in the question of marine reserve size. It was this impasse that precluded the group from arriving at consensus on a single map. By not accomplishing its assigned task of forwarding a single, marine reserve design to the SAC, it would be easy to assert that the MRWG effort was in many ways a failure.

In which ways was the effort a failure? First, habitat protection for the Channel Islands was delayed. The time between the MRWG disbanding and the eventual implementation of the current MPA network was postponed nearly two years. Second, an opportunity for the full group of stakeholders to produce an acceptable product was lost. The time dedicated by the MRWG participants to ensure that their respective conservation, sustainability, socioeconomic, cultural and educational interests would be assimilated into a specific reserve design never came to fruition. Lastly, the current MPA network is not supported by the full community as evidenced by the results of this alternative process currently being challenged in the courts by a coalition formed by commercial and recreational fishermen in southern California. In summary, what could have been a full, community-based, “bottom-up” strategy for designing a network of fishing set-asides at the Channel Islands was inverted to a “top-down” approach that alienated many in the fishing community.

Yet there were successes as well. While marine reserve size did become the primary obstacle in reaching a single map consensus, it is important to make the distinction between areas identified for potential closure and the total size of the proposed network. Credit is due the MRWG for agreeing upon nine different locations with the Sanctuary for potential fishing closures. In the numerous attempts to prepare a consensus map, the MRWG always started with the west end of the Sanctuary (i.e., San Miguel Island) and proceeded eastward in determining which areas to close. Proposed parcels at San Miguel, Santa Rosa, and portions of Santa Cruz Islands proceeded almost effortlessly. The really contentious debates did not occur until potential closures at Anacapa Island, the western tip of Santa Cruz Island, and Santa Barbara Island were discussed. These areas were favored fishing grounds by the recreational sector of the fishing community due primarily to their logistical proximity to mainland harbors. The recreational fishing sector was less willing to concede large parcels for closure at these islands. Confounding the debate was the fact that Santa Barbara Island was already receiving partial harvest restrictions as part of the “cowcod conservation area” (Figure 2). Because it was not a full fishing closure, as prescribed in SAC’s instructions, many members of the MRWG argued for additional closures at this island. While some areas of agreement were located at Anacapa and Santa Cruz Islands, none were identified at Santa Barbara Island.

Despite the lapse in agreement at the western part of the Sanctuary, the areas of overlap can be viewed as one of the successes of the MRWG and illustrates the value of using fishermen’s knowledge and experience in MPA design (Neis, 1995; Johannes, Freeman, & Hamilton, 2000; Manson & Die, 2001). Up until its last meeting, these areas represented 18% of the Sanctuary’s boundaries. As mentioned, this proportion was reduced during the final hours of the meeting and consequently never received the benefit of discussion among the MRWG as to whether other locations could be closed to offset the suggested changes. This last-minute change illustrates the viewpoints of particular fisheries that had not been actively involved in the process and highlights the importance of maximum outreach throughout the process.

Maneuvering around the Impasse

In retrospect, it is unfortunate that the deadlock over total reserve size was not recognized as an insurmountable obstacle early in the MRWG process. As the group became handicapped over the habitat quantity issue, they apparently did not consider approaching their task differently.

One approach they could have considered was to critique the quality of the habitat in the areas of overlap. Habitat quality forms an integral aspect in MPA design, and while not empirically tested, high quality habitats are likely to sustain higher rates of recovery than lower quality habitats (Rodwell et al., 2003). In the context of generating fishery benefits, marine reserves theoretically serve as a source of replenishment for the fishery by the export of larval recruits and the spillover of adults from the reserve into adjacent fishing areas (Roberts & Polunin, 1991; Carr & Reed, 1993; Rowley, 1994; Sladek Nowlis & Roberts, 1999). To maximize this mechanism requires protecting locations known to contain the highest concentrations of adult fish, because such locations support nursery and spawning functions (Dugan & Davis, 1993; Piet & Rijnsdorp 1998; Guénette, Lauck, & Clark, 1998; Mangel, 2000b; Crowder et al., 2000, NRC, 2001). These areas may also be considered "source" locations (*sensu* Pulliam, 1988), that is, sites with net exportation of individuals[4] as opposed to sites with net importation or "sinks." Source habitats may be more appropriate for locating reserves rather than situating them randomly or mistakenly placing them in "sink" locations (Guénette, Lauck, & Clark, 1998; Crowder et al., 2000; Tuya, Soboil, & Kido, 2000; Jamieson & Levings, 2001).

What was the quality of the areas conceded by the fishermen during the months of map preparation? Several sites known to be productive were identified by a collaborative process utilizing a GIS-based siting algorithm (Airamé et al., 2003) complemented with input from the fishing community. These areas included the Richardson Rock area off San Miguel Island, areas off Carrington Point and South Point on Santa Rosa Island, the Gull Island area off Santa Cruz Island, and the "Footprint" area between Anacapa and Santa Cruz Islands. Admittedly, some of the sites were logistically inconvenient to reach. Also, some areas (e.g., the "Footprint" area) may not have been as productive in recent years, possibly resulting from fishing pressure, episodic shifts in oceanographic regimes, or a combination of the two. Regardless, these locations were productive fishing grounds or had the potential to recover. Obviously, fishermen can identify areas where they are most likely to catch fish and these areas are likely to be population "sources" (Crowder et al., 2000; Sumaila et al. 2000).

Another basic question the MRWG could have asked themselves to reconcile their stalemate was whether a consensus design would be treated as an experiment or as a final solution. This query would have introduced the notion of accommodating an adaptive management approach into the design process. The group may have come to terms with approving a consensus map had they an understanding that adjustments, based on monitoring feedback and set performance measures, would be part of any design agreement. Such an approach would have also allowed examining potential impacts from a redistribution of fishing effort (Holland, 2002). It could be argued that had the group taken a habitat quality approach and arranged to experimentally manage proposed closed areas, their chances of reaching agreement on a single map may have improved.

Continuing MPA Efforts

The purpose of this article has been to examine particular decisions and courses of action taken by the MRWG that ultimately interfered with its ability to prepare a consensus map. Collectively, these events created a working situation making it exceedingly difficult for the MRWG to reach agreement on a single map. However, the MRWG's efforts may have been ill-fated from the very outset due to their directive to only consider "no-take" marine reserves as the sole MPA option. The consideration of just "no-take" areas seems to have originated with the Channel Islands Marine Resource Restoration Committee's initial proposal to the Commission. This approach remained unchanged as instructions were passed from the Commission through the SAC and ultimately to the MRWG. Agardy et al. (2003) argued that "multiple-use" MPAs, that is, areas with mixed, restricted, or exclusive harvest prohibitions, may be one approach to accommodate the various demands of the community. But this may be a difficult concept to advance. Certain opinions expressed by some MPA proponents during the MRWG effort suggest the existence of strong convictions that anything less than complete fishing closures are inadequate for achieving the ecosystem biodiversity goal.

Are complete fishing closures the only approach for attaining biodiversity? The question is beyond the scope of this paper but it certainly needs to be a topic at the forefront of the MPA debate. Simultaneously, MPA proponents need to recognize that regardless of the intended outcomes of ecosystem biodiversity or sustainable fishery goals, the means to accomplish both are the same: fishermen are regulated. Consequently, it may be unreasonable to expect fishermen to sacrifice excessively large areas when other fishery management measures are already in place and the efficacy of marine reserves is still poorly understood (Soh, Gunderson, & Ito, 2001; Polunin, 2002; Willis et al., 2003). This underscores the need to not treat MPA efforts independently of existing fishery management regulations, but rather to effectively integrate and manage them adaptively. Integration and adaptive management may be key tactics for removing the fishing community's perception that they are being unfairly targeted and excessively regulated. This is an important point to note, especially as various states, NOAA's National Marine Sanctuary Program, and the Fishery Management Councils continue efforts to improve marine conservation by considering spatial closures. These various endeavors similarly need to address whether both goals can be accomplished by closing the same areas and the degree that fishing practices need to be curtailed in these areas.

As MPA efforts proceed, the importance of keeping the fishing community engaged remains critical as the alternative becomes counterproductive to marine conservation. For example, the new fishing coalition formed in southern California not only represents a new level of collaboration between these divergent fisheries, but also challenges the legal merits of the MPA network currently in place. While it can be claimed that the Channel Islands National Marine Sanctuary represents one of the largest MPA networks in U.S. waters, its status remains unsettled in the courts. One could also infer that the backlash from the fishing community has interfered with California's efforts to simultaneously implement the Marine Life Protection Act (MLPA) along its shoreline. Not only was the initial attempt at designating MPAs in this state process discarded, but implementation of a revised effort has been placed on indefinite hold due to the state's budgetary crisis. It is reasonable to assume that the MLPA effort was ranked lower in the state's budget priorities due to criticisms arising from a galvanized fishing community. Similarly, efforts to establish greater habitat protection at NOAA's three other National Marine Sanctuaries in California will now face rigorous scrutiny.

There is another aspect that highlights the importance of keeping the fishing community engaged. The assistance of fishermen in locating source sites is absolutely crucial to any MPA process and conforms with the view that participants in the fishery have a responsibility to provide information required to manage fisheries in a sustainable manner (NMFS, 1999). Likewise, their support is needed to achieve effective compliance once an MPA design is implemented. Without their continued involvement, the chances of successfully achieving biodiversity and sustainable fishery goals are reduced (Manson & Die, 2001; Agardy et al., 2003). Consequently, MPA proponents should utilize fishermen's knowledge but also remain reasonable in their demands of what they should concede. Proponents also need to recognize that by exclusively focusing on living marine resources, they overlook the risk of collapse in the fishing community (Hilborn et al., 2001).

Efforts to foster marine conservation will always face stiff challenges. Differences of opinion will need to be confronted on a case-by-case basis and negotiations need to include the full community. MPA planners will also need to develop effective outreach mechanisms to ensure that all sectors of the fishing community are involved beyond just those participating at the planning table. This was an oversight that manifested itself with last-minute changes at the MRWG's last meeting. Serious consideration should also be given to employing the array of options in the MPA toolkit specific to their circumstances and not just focusing on "no-take" marine reserves (Agardy et al., 2003). Planners and managers involved will need to look for warning signs so that impending obstacles to progress are recognized and managed early in the process.

Notes

1. The Sanctuary is located 22 nmi off the coast of Santa Barbara, California and extends 6 nmi offshore of the waters surrounding the northern Channel Islands of Anacapa, Santa Cruz, Santa Rosa, San Miguel, and Santa Barbara.

2. The 18% figure endured over a several-month period in the MRWG discussions until the last hours of its last meeting, when concerns expressed by some fisheries whittled the areas of agreement down to 12%. This last-minute modification received neither the benefit of any MRWG discussion nor the opportunity for alternative options to be proposed and reviewed by the group. For discussion purposes, the 18% figure is used as the basis of this article.

3. The criteria included local knowledge, expertise in ecological and physical processes, a geographic and institutional balance, participation on the NCEAS Reserve Theory Working Group, and availability. Consideration was also given to institutional representation from state and federal natural resource agencies.

4. These productive areas mirror the NOAA Fisheries concept of "habitat areas of particular concern" (HAPC) as defined in the Essential Fish Habitat (EFH) regulations under the Magnuson-Stevens Act for habitats that provide important ecological functions.

References

Agardy, T., P. Bridgewater, M. P. Crosby, J. Day, P. K. Dayton, R. Kenchington, D. Laffoley, P. McConney, P. A. Murray, J. E. Parks, and L. Peau. 2003. Dangerous targets? Unresolved issues and ideological clashes around marine protected areas. *Aquatic Conservation: Marine and Freshwater Ecosystems* 13:353–367.

Airamé, S., J. E. Dugan, K. D. Lafferty, H. Leslie, D. A. McArdle and R. R. Warner. 2003. Applying ecological criteria to marine reserve design: A case study from the California Channel Islands. *Ecological Applications* 13:S170–S184.

Allison, G. W., J. Lubchenco, and M. H. Carr. 1998. Marine reserves are necessary but not sufficient for marine conservation. *Ecological Applications* 85:S79–S92

Apostolaki, P., E. J. Milner-Gulland, M. K. McAllister, and G. P. Kirkwood. 2002. Modelling the effects of establishing a marine reserve for mobile fish species. *Canadian Journal of Fisheries and Aquatic Sciences* 59:405–415.

Bohnsack, J. A. 1998. Application of marine reserve to reef fisheries management. *Australian Journal of Ecology* 23:298–304.

Bohnsack, J. A. 1999. *Incorporating no-take marine reserves into precautionary management and stock assessment*. Proceedings, 5th NMFS NSAW: Providing Scientific Advice to Implement the Precautionary Approach Under the Magnuson-Stevens Fishery Conservation and Management Act, ed. V. R. Restrepo, 8–16. NOAA Tech. Memo. NMFS-F/SPO-40, 16 pp.

Botsford, L. W., F. Micheli, and A. Hastings. 2003. Principles for the design of marine reserves. *Ecological Applications* 13:S25–S31.

Carr, M. H., and D. C. Reed. 1993. Conceptual issues relevant to marine harvest refuges: Examples from temperate reef fishes. *Canadian Journal Fisheries and Aquatic Sciences* 50:2019–2028.

Crowder, L. B., S. J. Lyman, W. F. Figueira and J. Priddy. 2000. Source-sink population dynamics and the problem of siting marine reserves. *Bulletin of Marine Science* 66:799–820.

DeMartini, E. E. 1993. Modeling the potential of fishery reserves for managing Pacific coral reef fishes. *Fishery Bulletin* 91:414–422

Dugan, J. E., and G. E. Davis. 1993. Applications of marine refugia to coastal fisheries management. *Canadian Journal Fisheries and Aquatic Sciences* 50:2029–2042.

Fiske, S. J. 1992. Sociocultural aspects of establishing marine protected areas. *Ocean & Coastal Management* 17:25–46.

Guénette, S., and T. J. Pitcher. 1999. An age-structured model showing the benefits of marine reserves in controlling overexploitation. *Fisheries Research* 39:295–303.

Guénette, S., T. Lauck, and C. Clark. 1998. Marine reserves:from Beverton and Holt to the present. *Reviews in Fish Biology and Fisheries* 8:251–272.

Gunderson, L. 1999. Resilience, flexibility and adaptive management - antidotes for spurious certitude? *Conservation Ecology* 3(1):7; available online at http://www.consecol.org/vol3/iss1/art7.

Halpern, B. 2003. The impact of marine reserves: Do reserves work and does reserve size matter? *Ecological Applications* 13:S117–S137.

Hilborn, R., J. Maguire, A. M. Parma and A. A. Rosenberg. 2001. The Precautionary Approach and risk management: Can they increase the probability of successes in fishery management? *Canadian Journal Fisheries and Aquatic Sciences* 58:99–107

Holland, D. S. 2002. Integrating marine protected areas into models for fishery assessment and management. *Natural Resource Modeling* 15:369–386.

Jamieson, G. S., and C. O. Levings. 2001. Marine protected areas in Canada—implications for both conservation and fisheries management. *Canadian Journal Fisheries and Aquatic Sciences* 58:138–156.

Jennings, S. 2001. Patterns and prediction of population recovery in marine reserves. *Reviews in Fish Biology and Fisheries* 10:209–231.

Johannes, R. E. 1978. Traditional marine conservation methods in oceania and their demise. *Annual Reviews of Ecology and Systematics* 9:349–364

Johannes, R. E., M. M. R. Freeman, and R. J. Hamilton. 2000. Ignore fishers' knowledge and miss the boat. *Fish and Fisheries* 1:257–271.

Jostes, J. C., and M. Eng. 2001. Facilitator's report regarding the Channel Islands National Marine Sanctuary Marine Reserves Working Group. Report prepared for the CINMS Sanctuary Advisory Council, http://channelislands.noaa.gov/marineres/fac_report_web.pdf.

Kramer, D. L., and M. R. Chapman. 1999. Implications of fish home range size and relocation for marine reserve function. *Environmental Biology of Fishes* 55:65–79.

Lubchenco, J., S. R. Palumbi, S. E. Gaines and S. Andelman. 2003. Plugging a hole in the ocean: The emerging science of marine reserves. *Ecological Applications* 13:S3–S7.

Mangel, M. 2000a. On the fraction of habitat allocated to marine reserves. *Ecological Letters* 3:15–22.

Mangel, M. 2000b. Trade-offs between fish habitat and fish mortality and the role of reserves. *Bulletin of Marine Science* 66:663–674.

Manson, F. J., and D. J. Die. 2001. Incorporating commercial fishery information into the design of marine protected areas. *Ocean & Coastal Management* 44:517–530.

McClanahan, T. R., and S. Mangi. 2000. Spillover of exploitable fishes from a marine park and its effect on the adjacent fishery. *Ecological Applications* 10:1792–1805.

Murawski, S. A., R. Brown, H.-L. Lai, P. J. Rago, and L. Hendrickson. 2000. Large-scale closed areas as a fishery-management tool in temperate marine systems: The Georges Bank experience. *Bulletin of Marine Science* 66:775–798.

Murray, S.N., R. F. Ambrose, J. A. Bohnsack, L. W. Botsford, M. H. Carr, G. E. Davis, P. K. Dayton, D. Gothshall, D. R. Gunderson, M. A. Hixon, J. Lubchenco, M. Mangel, A. MacCall, D. A. McCardle, J. C. Odgen, J. Roughgarden, R. M. Starr, M. I. Tegner, and M.M. Yoklavich. 1999. No-take reserve networks: Sustainable fishery populations and marine ecosystems. Fisheries Management Perspective. *Fisheries* 24:11–25.

National Marine Fisheries Service (NMFS). 1999. *Ecosystem-based fishery management: A report to Congress by the Ecosystem Principles Advisory Panel.* United States Department of Commerce, National Oceanic and Atmospheric Administration, NMFS, Silver Spring, MD, 54 pp.

National Research Council (NRC). 2001. *Marine protected areas: Tools for sustaining ocean ecosystems.* Washington, DC: National Academy Press, 272 pp.

Neis, B. 1995. *Fisher's ecological knowledge and marine protected areas.* In Marine protected areas and sustainable fisheries, ed. N. L. Shackell and J. H. M. Willison, 265–272. Wolfville, NS, Canada: Science and Management of Protected Areas Association.

Pacific Fishery Management Council (PFMC). 2001. Scientific and Statistical Committee report on status of marine reserves proposals for Channel Island National Marine Sanctuary. Exhibit F.1.c, Supplemental SSC Report, Pacific Fishery Management Council Meeting, November, 2001, http://www.pcouncil.org/reserves/recent/sscreport.html.

Parma, A. M., and NCEAS Working Group on Population Management. 1998. What can adaptive management do for our fish, forest, food and biodiversity? *Integrative Biology* 1:16–26.

Parrish, R. 1999. Marine reserves for fisheries management: Why not? *California Cooperative Oceanic Fisheries Investigations Reports* 40:77–86.

Piet, G. J., and A. D. Rijnsdorp. 1998. Changes in the demersal fish assemblage in the south-eastern North Sea following the establishment of a protected area ("plaice box"). *ICES Journal of Marine Science* 55:420–429.

Polacheck. T. 1990. Year round closed areas as a management tool. *Natural Resource Modeling* 4:327–53.

Pomeroy, C. 1999. Social consideration for marine resource management: Evidence from Big Creek Ecological Reserve. *California Cooperative Oceanic Fisheries Investigations Reports* 40:118–125.

Polunin, N. 2002. Marine protected areas, fish and fisheries. In *Handbook of Fish Biology and Fisheries Vol. II*, ed. P. J. B. Hart and J. D. Reynolds, 293–318. Malden, MA: Blackwell Science Ltd.

Pullium, H. R. 1988. Sources, sinks, and population regulation. *American Naturalist* 132:652–661.

Roberts, C. M., and N. V.C. Polunin. 1991. Are marine reserves effective in management of reef fisheries? *Reviews in Fish Biology and Fisheries* 1:65–91.

Roberts, C. M., J. A. Bohnsack, F. Gell, J. P. Hawkins, and R. Goodridge. 2001. Effects of marine reserves on adjacent fisheries. *Science* 294:1920–1923.

Rodwell, L. D., E. B. Barbier, C. M. Roberts, and T. R. McClanahan. 2003. The importance of habitat quality for marine reserve-fishery linkages. *Canadian Journal of Fisheries and Aquatic Sciences* 60:171–181.

Rogers-Bennett, L. (ed.). 2001. Review of some California fisheries for 2000. *California Cooperative Oceanic Fisheries Investigations Reports* 42:12–28.

Rowley, R. J. 1994. Case studies and reviews: Marine reserves in fisheries management. *Aquatic Conservation Marine Freshwater Ecosystems* 4:233–254.

Science Advisory Panel (SAP). 2001. How large should marine reserves be? Draft technical report presented to the Science and Statistical Committee, Pacific Fishery Management Council, October 17, 2001, 23 pp.

Sladek Nowlis, J., and C. M. Roberts. 1999. Fisheries benefits and optimal design of marine reserves. *Fishery Bulletin* 97:604–616.

Soh, S., D. R. Gunderson, and D. H. Ito. 2001. The potential role of marine reserves in the management of shortraker rockfish (*Sebastes borealis*) and rougheye rockfish (*S. aleutianus*) in the Gulf of Alaska. *Fishery Bulletin* 99:168–179.

Stobutzki, I. C. 2001. Marine reserves and the complexity of larval dispersal. *Review in Fish Biology and Fisheries* 10:515–518.

Sumaila, U. R., S. Guénette, J. Alder, and R. Chuenpagdee. 2000. Addressing ecosystem effects of fishing using marine protected areas. *ICES Journal of Marine Science* 57:752–760.

Thomson, C. 1998. *Evaluating marine harvest refugia: An economic perspective.* In Marine harvest refugia for West Coast rockfish: A workshop, ed.. M. Yoklavich, 78–83. NOAA-TM-NMFS-SWFSC-255.

Tuya, F. C., M. L. Soboil, and J. Kido. 2000. An assessment of the effectiveness of marine protected areas in the San Juan Islands, Washington, USA. *ICES Journal of Marine Science* 57:1218–1226.

Ugoretz, J. 2002. Final 2002 environmental document: Marine protected areas in the National Oceanic and Atmospheric Administration's Channel Islands National Marine Sanctuary, Volume 1. California Department of Fish and Game, State Clearing House No. 2001121116, http://www.dfg.ca.gov/mrd/channel_islands

Willis, T. J., R. B. Millar, R. C. Babcock, and N. Tomlimieri. 2003 Burdens of evidence and the benefits of marine reserves: Putting Descartes before des horse? *Environmental Conservation* 30:97–103.

White, A. T., C. A. Courtney, and A. Salamanca. 2002. Experience with marine protected area planning and management in the Philippines. *Coastal Management* 30:1–26

Zeller, D. C., and G. R. Russ. 1998. Marine reserves: Patterns of adult movement of the coral trout (*Plectropomus leopardus* (Serranidae)). *Canadian Journal Fisheries and Aquatic Sciences* 55:917–924.